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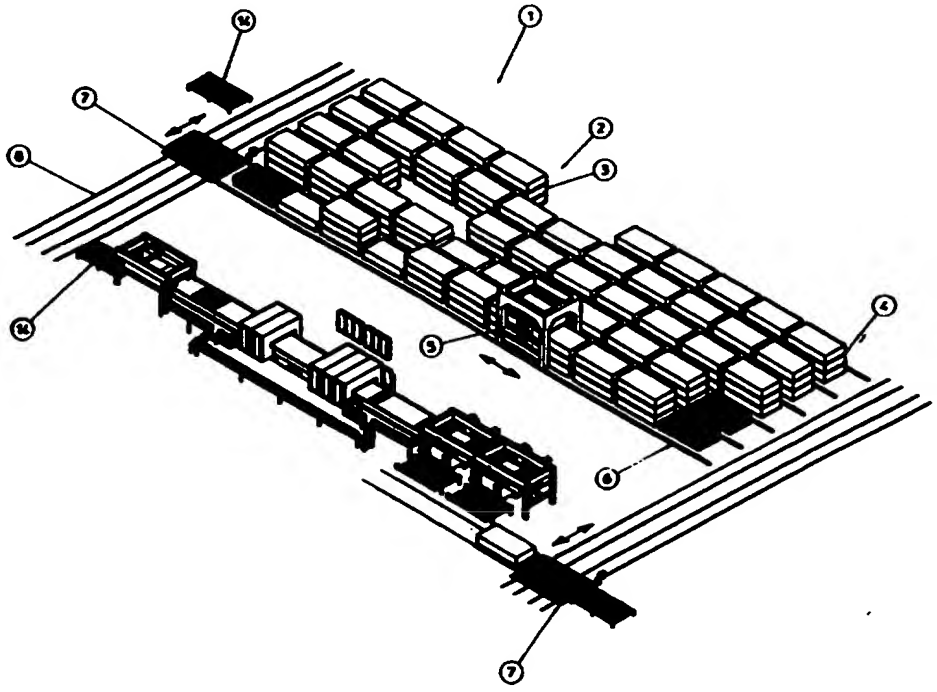

(57) Abstract

The inventi n relates to a method and apparatus for handling sheet stacks, in which method sheet stacks (2) comprising at least one sheet are moved into a storage (1) with the help of handling apparatuses into sheet piles (3) of at least one sheet stack. By virtue of purpose-designed support beds (4), a handling apparatus (7) and a straddle carrier (5), a flexible and efficient buffer storage system for sheet stacks is offered suited for interfacing with existing sheet processing lines.

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A method and apparatus for handling sheet stacks

The present invention relates to a method according to the preamble of claim 1 for handling sheet stacks. The invention also concerns a method according to the preamble of claim 4 for handling sheet stacks.

Furthermore, the invention relates to an apparatus according to the preamble of claim 7 for handling sheet stacks.

Known in the art are handling systems for sheet stacks in which the storage of the sheet stacks is implemented using stacker trucks. However, the use of stacker trucks requires plenty of space between the piled sheet stacks and wide truck aisles. Moreover, storage handling of sheet stacks using stacker trucks is difficult to automate.

Also known are systems using transfer beds for the transport of sheet stacks to the storage. The sheets are stacked in high piles which are then transferred to the storage by means of a transfer bed. The transfer beds travel in the storage under sheet stacks piled on supports such as concrete pillars. Such systems are hampered by, i.a., the limitation that sheet stacks piled in the storage can be picked from the storage only in a certain order, which prevents random picking of the sheet stacks, e.g., directly from the center of the sheet stack storage. Moreover, the storage requires complicated and expensive foundations.

Further known is a storage system in which the sheet stacks are stored on a pallet with a planar top surface. After stacking, a lift carrier is used to transf r the sheet stack piled on the pallet to the storage. In practice the handling of such sheet stack pallets has

prov n complicated. They require purpose-design d handling equipment to be used on the processing lines of the sheets. The pallet must be transferred into a stacking station, where the sheets are piled one by one into stacks onto the pallet. When unloading the sheets from such a pallet, the sheets must again be removed one by one from atop the pallet for use on a processing line. Having a conventional construction, the pallets require an operating environment comprising dedicated handling equipment, a pallet storage from which they are fed to the stacking device of the processing line of the sheets, and additionally, equipment for collection and transfer of the pallets back to the storage. Such arrangements are often extremely complicated and require different kinds of equipment for handling the pallets.

It is an object of the present invention to provide a method and apparatus capable of overcoming the disadvantages of conventional techniques.

More specifically, the method according to the invention is characterized by what is stated in the appended claims.

The embodiment according to the invention offers a plurality of significant benefits. The pallet construction employed in the system according to the present invention makes it possible, i.a., that the pallet obviates the need for dedicated feed and stacking equipment on the processing lines of the sheets. Moreover, the pallet stays all the time in the storage equipment or the storage area, whereby no space reservation is required along the processing lines for the pallet stacks. This arrangement further assures that the pallet would inadvertently land into the sheet-processing line. Moreover, the clumsiness of separate circulation and collection of the pallets is avoided. The capacity of the

present system is improved particularly by the property that a plurality of pallets may be piled atop each other in the handling apparatus. Thus, the handling apparatus can perform a second function as a sort of buffer storage for the pallets.

In the following the invention will be examined in greater detail with reference to an exemplifying embodiment illustrated the appended drawings, in which

Figure 1 is a perspective top view of a handling apparatus according to the invention;

Figure 2 is a top view of a support bed employed in the apparatus;

Figure 3 is a side view of a transfer bed employed in the apparatus;

Figure 4 is an enlarged detail of Fig. 3;

Figure 5 is a top view of the transfer bed; and

Figure 6 is a perspective view of the straddle carrier entering the transfer bed.

Referring to Fig. 1, an embodiment of a sheet handling apparatus according to the invention is shown therein. The apparatus layout includes a storage area 1 in which the sheet stacks 2 are stored in piles 3. The sheet stacks 3 arranged in rows of successive stacks form a storage row. The number of successive sheet stacks in a row as well as the number of parallel storage rows may be varied as required. The sheet stacks 2 are piled on a support bed 4 called a pallet later in the text. Transfer of the sheet stacks 2 and the pallets 4 in the storage is arranged by means of a straddle carrier 5. The straddle

carrier 5 is advantageously of the wheeled straddle carrier type of overhead crane also known as a lukki carrier, whereby the sheet stack to be lifted and transferred is moved elevated between the high wheeled legs of the straddle carrier. The straddle carrier is arranged to move along a track 6 formed by, e.g., rails with the help of conventional drive means. The straddle carrier 5 is equipped with a lift device capable of moving the sheet stacks with their pallets into the storage piles 3 and off the storage piles, respectively. Each storage row is situated between a pair of adjacent rails 6 forming the track, whereby the storage row remains between the wheeled legs of the straddle carrier.

An essential part of the system is a handling apparatus 7. The handling apparatus is equipped with transfer elements 9 suited for receiving a sheet stack 2 from, e.g., processing lines and forwarding them to further processing. The pallet 4 is adapted to fit onto the handling apparatus 7 so that the top level of the transfer elements 9 of the handling apparatus and the lower surface of the sheet stack 2 are in contact with each other when the pallet 4 is in the handling apparatus. Most advantageously, the pallets 4 are lowered onto support members such as beams adapted to the frame of the handling apparatus.

According to a preferred embodiment, the pallet is formed by two longitudinal support beams 11, 12 between which is adapted a plurality of transverse support beams 13. The longitudinal support beams 11, 12 are shaped to provide, or alternatively, are equipped with projections at which the lift of a straddle carrier 5 can elevate the pallet. The pallet has a ladder construction. Thus, the transverse support beams 13 form a support structure under the sheet stack being handled. The pallet can b lowered onto the handling apparatus so that the transfer elements 9 or

at least a portion thereof are aligned b tween the longitudinal support beams 11, 12 and the transverse support beams 13 can negotiate the gap between the adjacent transfer elements 9, whereby the sheet stack 2 remains supported by the transfer elements 9 when the pallet 4 is lowered below the top level of the transfer elements. The dimensions of the pallet 4 are advantageously larger than the largest sheet size being handled. When desired, several sheet stacks with smaller dimensions can be piled adjacently on a single pallet.

In the above-described exemplifying embodiment, a transfer bed 7 arranged to travel transversely oriented relative to the storage rows is used as the handling apparatus. The transfer bed 7 is most advantageously adapted to run along a track 8. In the case illustrated in Fig. 1, the storage area is provided with two transfer beds which are located at the opposite ends of the storage rows. The transfer bed is provided with transfer elements 9 for receiving a sheet stack from, e.g., processing lines and transferring them from the bed to further processing. Additionally, the transfer bed is equipped with rails 10 along which the straddle carrier 5 can run onto the transfer bed 7. The transfer elements 9 are advantageously comprised of a roller track which is powered by means of an electric drive such as an electric motor and a chain transmission train. The bottom surface of the lowermost sheet in the sheet stack 2 is in contact with the transfer elements 9 of the transfer bed.

When transferring a sheet stack from the processing line to the storage, a pallet 4 is placed on a transfer bed 7, which next moves to a reception position 14 where the sheet stack 2 is moved, advantageously with the help of conveyor means, onto the transfer bed 7, onto the transfer elements 9. The transfer bed 7 is next moved along rails 8 to that storage row where the straddle carrier 5

is locat d. The straddle carrier 5 is driven onto the transfer bed 7. The transfer bed 7 with the straddle carrier 5 now on it is driven to that storage row into which the sheet stack is intended to be piled. The lift device of the straddle carrier grabs the uppermost pallet 4 loaded on the transfer bed 7 at the pallet corners, thereby lifting the pallet and simultaneously the sheet stack 2 resting on it off from the transfer bed. The straddle carrier 5 moves off from the transfer bed 7 onto the rails 6 of the storage row and transfers the sheet stack 2 into the desired storage position.

When transferring a sheet stack 2 from the storage to, e.g., a sheet-processing line, the lift device of the straddle carrier 5 picks from a storage pile 3 the pallet 4 on which the sheet stack rests and elevates the pallet with the sheet stack 2 resting on it. Next, the straddle carrier 5 moves along its track to the transfer bed 7 which has moved at the same storage row. After the rails 10 of the transfer bed 7 are aligned with the rails of the track 6 of the straddle carrier 5, the straddle carrier 5 moves on the rails onto the transfer bed and lowers there the pallet with the sheet stack onto the transfer bed 7. The pallet 4 is lowered supported by the transfer elements 9 of the transfer bed below the top level of the support bed, while the sheet stack 2 is left resting on the transfer elements 9. The straddle carrier 5 is moved from the transfer bed 7 to the storage track 6 and the transfer bed 7 moves into a position, where the sheet stack is intended to be transferred to further processing, such a position being a feed conveyor 14 of a sheet-processing line, for instance. The transfer elements 9 of th transfer bed such as rollers move the sheet stack 2 to the conveyor 14 of the processing line, where the pallet 4 remains on the transfer bed 7. Also in this case the pallet 4 need not be moved away from the equipment of the storage system to the processing line

area. The sheet stacks 2 may be removed from th pall ts 4 in stacks and not as single sheets. The transfer bed 7 is immediately ready to receive a new task from the control equipment of the storage system.

In an embodiment of the invention, a number of the pallets 4 may be stacked on one another (cf. Figs. 3 and 4) on the transfer bed 7 so that the top surface of the uppermost pallet 4 remains below the upper level of the transfer elements 9 of the transfer beds. Accordingly, the transfer bed 7 is provided with sufficient space to accommodate a number of support beds 4 of which the top level of the uppermost support bed remains lower than the top level of the transfer elements 9. This detail contributes essentially to the high transfer capacity of the storage system according to the invention. Hence, the transfer bed 7 can serve as a storage buffer for the pallets 4. Such a property is particularly advantageous when the capacity of the processing line feeding the sheet stacks into the storage differs essentially from the capacity of the processing line consuming the sheet stacks from the storage. This property thus makes the pallet handling more flexible and faster.

The straddle carrier 5 is equipped with devices (not shown) for the positional location of the pallet 4. The system includes sensor elements such as photosensors adapted to the grabber elements 15 of the lift unit of the straddle carrier and corresponding identification means adapted to the pallet 4 such as reflective areas. The grabber elements 15 grab the pallet 4 at least by two edges on opposite sides of the pallet. The grabber elements 15 are additionally provided with conventional interlock means assuring positive hold of the grabber lements on the pallet. Such interlock elements are, i.a., inductive proximity sensors and pressure switches

included in the pressurized-m dium drive system actuating the grabber elements.

The straddle carrier 5 is also arranged to receive and transfer a desired number of empty pallets 4 from one place to another. Owing to the flexibility of the storage system according to the invention, the user may freely define the storage locations used for storing the empty pallets 4. In practice, the empty pallets are typically stored stacked in piles close to the track of the transfer bed 7, advantageously in the first storage position of the storage row. In a storage having transfer beds at both ends of the storage row, the empty pallets are stored at both ends of the storage row.

The transfer bed is most advantageously adapted movable on wheels 16 running on rails. The wheels are driven by a drive system comprising at least one electric motor 17 driven by a frequency converter. In the embodiment illustrated in the drawings, the transfer elements 9 of the transfer bed comprise a roller track and a drive system actuating the roller track by means of an electric motor and a chain transmission comprised of chains and chain sprockets. Further, the transfer bed includes rails 10 for the roll-in of the straddle carrier 5 along said rails 10 onto said transfer bed 7. The straddle carrier 5 drives onto the transfer bed in the following occasions: to move from one storage row to another; to lift sheet stack from transfer bed to storage; to lift sheet stack from storage onto transfer bed; to lift empty pallets from transfer bed into storage; and to lift empty pallets from storage onto transfer bed.

In the system according to the invention, the pallet is used every time the sheet stack is lifted and moved by means of the straddle carrier.

Now referring to Fig. 6, the roll-in of the straddle carrier 5 onto the transfer bed 7 is elucidated in detail.

The storage system, straddle carrier and transfer bed are controlled by an automatic control system comprising, e.g., at least one programmable logic control unit and a storage management system run by a computer. Obviously, such a system also facilitates the use of manual control.

In another preferred embodiment the handling apparatus 7 may be, e.g., a conveyor (not shown) capable of transferring the sheet stack to further processing or onto a transfer bed so that the support bed remains on the conveyor. Then, the end of each storage row is equipped with a conveyor capable of handling the support bed and on which conveyor the sheet stack can be moved by means of, e.g., a transfer cart when the support bed is already on the conveyor. Correspondingly, when the storage is being unloaded, the sheet stack is first moved by means of the straddle carrier onto the conveyor, which then transfers the sheet stack into the transfer cart, while the support bed remains on the conveyor. In such an arrangement, there are two separate handling apparatuses, of which one takes care of operations on the support bed and the other serves for the transfer of the sheet stacks. In the transfer bed 7 described for the exemplifying embodiment, these two functions are combined.

Typical transfer functions related to the storage operations in the manufacture of wood-based boards are, i.a.: transfer of sheet stack from press line to storage; transfer of sheet stack from storage to grinding line; transfer of sheet stack from storage to truck roller track; transfer of sheet stack to travelling crosscut saw unit; transfer of sheet stack to piling line; transfer of sheet stack from grinding line to storage; transfer of

empty pallets from pallet stack into mpty transfer cart; transfer of empty pallets from transfer cart to pallet stack of storage.

To those versed in the art it is obvious that the invention is not limited to the exemplifying embodiments described above, but rather, can be varied within the scope of the annexed claims. Thus, the handling apparatus 7 may comprise a variety of different apparatus embodiments. Additionally, the transfer elements 9 may be comprised of different types of conveyors.

Claims:

1. A method of handling sheet stacks, in which method sheet stacks (2) formed by at least one sheet are transferred into a storage (1) by means of handling apparatuses into sheet piles (3) formed by at least one sheet stack, c h a r a c t e r i z e d in that at least one support bed (4) is placed in the handling apparatus (7) so that the top level of the support bed remains below the top level of the transfer elements (9) of the handling apparatus (7), a sheet stack (2) is moved over the transfer elements (9) of the handling apparatus, the support bed (4) is elevated thereby lifting the sheet stack (2) along with the support bed (4) off from the transfer elements (9), the support bed (4) with the sheet stack (2) is moved to a storage position destined for the storage of the sheet stack and the support bed (4) with the sheet stack (2) resting on it is lowered into the storage position.

2. A method as defined in claim 1, c h a r a c t e r i z e d in that said handling apparatus is a wheeled transfer bed (7), whereby the sheet stack (2) is moved onto the transfer elements (9) of the transfer bed, the transfer bed (7) is moved along a track (8) to that end of a storage row where a straddle carrier (5) is located, the straddle carrier (5) is driven along the track (6) onto the transfer bed (7), the support bed (4) is elevated by means of the lift devices of the straddle carrier (5) thereby lifting the sheet stack (2) along with the support bed (4) off from the transfer elements (9), the straddle carrier (5) with the support bed (4) and the sheet stack (2) resting thereon is moved utilizing the transfer bed (7) as necessary to a storage row destined for the storage of the sheet stack (2), the straddle carrier (5) is moved into the storage row into the storage position destined for the storage of the sheet

stack and the support bed (4) with the sh et stack (2) resting thereon is lowered into the storage location.

3. A method as defined in claim 2, c h a r a c t e r - i z e d in that at least one empty support bed (4) is placed with the help of the lift device of the straddle carrier onto the transfer bed (7) prior to moving the sheet stack (2) onto the transfer bed.

4. A method of handling sheets stacks, in which method sheet stacks (2) formed by at least one sheet are transferred from a storage (1) by means of handling apparatuses from sheet piles (3) formed by at least one sheet stack to further processing, c h a r a c t e r i z e d in that a support bed (4) with the sheet stack (2) resting thereon is elevated by means of the lift device of a straddle carrier (5), the straddle carrier (5) with the support bed (4) and the sheet stack (2) resting thereon is moved onto a handling apparatus (7) located at the storage row, the support bed (4) with sheet stack (2) resting thereon is lowered onto the handling apparatus (7) thus placing the sheet stack to rest on transfer elements (9) of the handling apparatus and simultaneously permitting the support bed (4) to withdraw past said transfer elements (9) into a space reserved for the support bed, whereby the top level of the support bed (4) remains below the top level of the transfer elements (9), and the sheet stack (2) is finally moved, advantageously using the transfer elements (9), off from the handling apparatus (7), whereby the support bed (4) remains in the handling apparatus.

5. A method as defined in claim 4, c h a r a c t e r - i z e d in that, using a transfer bed (7) as the handling apparatus which is initially moved at a storage row, the support b d (4) with the sheet stack (2) resting thereon is lowered onto the transfer bed (7) thus placing

the sheet stack to rest on the transfer elements (9) of the handling apparatus and simultaneously permitting the support bed (4) to withdraw past said transfer elements (9) into a space reserved for the support bed, whereby the top level of the support bed (4) remains below the top level of the transfer elements (9), the straddle carrier (5) is next moved away from above the transfer bed (7), the transfer bed (7) is moved to an output position (14), and the sheet stack (2) is finally moved, advantageously using the transfer elements, off from the transfer bed (7), whereby the support bed (4) remains on the transfer bed.

6. A method as defined in claim 5, c h a r a c t e r - i z e d in that an additional step is performed comprising moving unused support beds (4) with the help of the straddle carrier (5) off from the transfer bed (7) into a storage position of empty support beds.

7. An apparatus for handling sheets stacks, said apparatus comprising handling means for moving sheet stacks (2) formed by at least one sheet into a storage (1) into sheet piles (3) formed by at least one sheet stack so as to align the successive sheet stacks into storage rows, and correspondingly, for moving said sheet stacks off from the storage (1), c h a r a c t e r - i z e d by at least one handling apparatus (7) and a support bed (4) for said sheet stacks (2), said handling apparatus (7) incorporating transfer elements (9) for receiving and/or delivering a sheet stack (2), and by having said support bed (4) constructed so that the bed may be adapted to withdraw into a space of said transfer bed (7) so that th top level of the support b d (4) remains below the top level of the transfer elements (9), and by a straddle carrier (5) adapted to move said support bed with a sh et stack resting ther on into and

off from a storage (1) into and off from said handling apparatus (7).

8. An apparatus as defined in claim 7, c h a r a c - t e r i z e d in that said support bed (4) is formed by longitudinal support beams (11, 12) bridged by transverse support beams (13) connecting the longitudinal support beams to each other.

9. An apparatus as defined in claim 7 or 8, c h a r - a c t e r i z e d in that said transfer elements (9) of said handling apparatus (7) comprise a conventional roller conveyor with sufficient space between the rollers to admit said transverse support beams (13) of said support bed (4).

10. An apparatus as defined in any of claims 7 - 9, c h a r a c t e r i z e d in that said handling apparatus (7) is adapted with a space to accommodate a number of support beds (4), whereby the top level of the uppermost support bed remains below the top level of said transfer elements (9).

11. An apparatus as defined in any of claims 7 - 10, c h a r a c t e r i z e d in that said handling apparatus comprises a wheeled transfer bed (7), said transfer bed (7) being adapted to move advantageously at the ends of said storage rows oriented orthogonally in relation to said storage rows.

12. An apparatus as defined in any of claims 7 - 11, c h a r a c t e r i z e d in that said transfer bed (7) is equipped with rails (10) for said straddle carrier (5).

13. An apparatus as defined in any of claims 7 - 12, c h a r a c t e r i z e d in that said apparatus is operated with the help of a control unit.

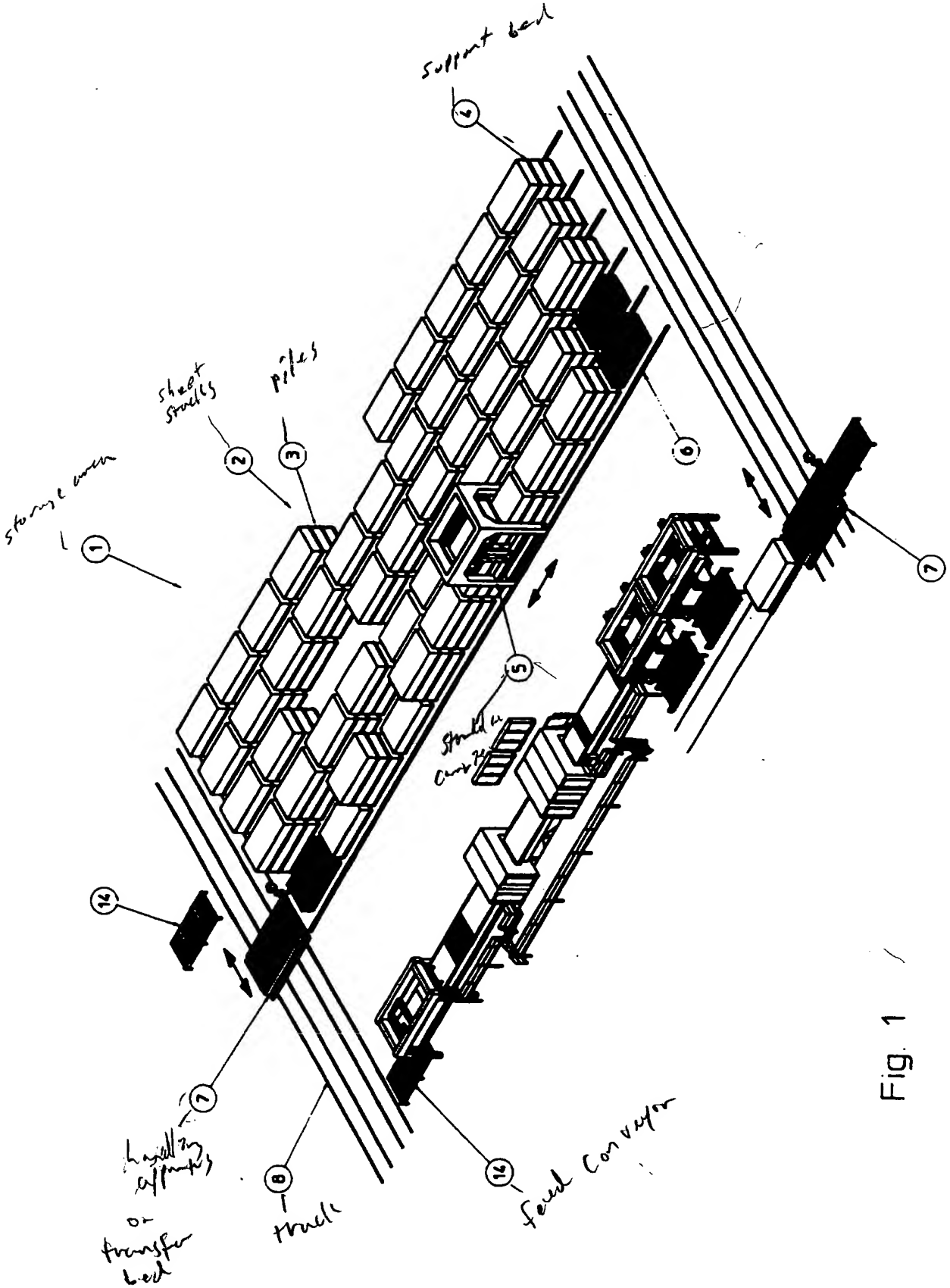
support bed
sheet
piles
storage
1
2
3
5
6
7
8
12
truck
feed conveyor

Fig. 1

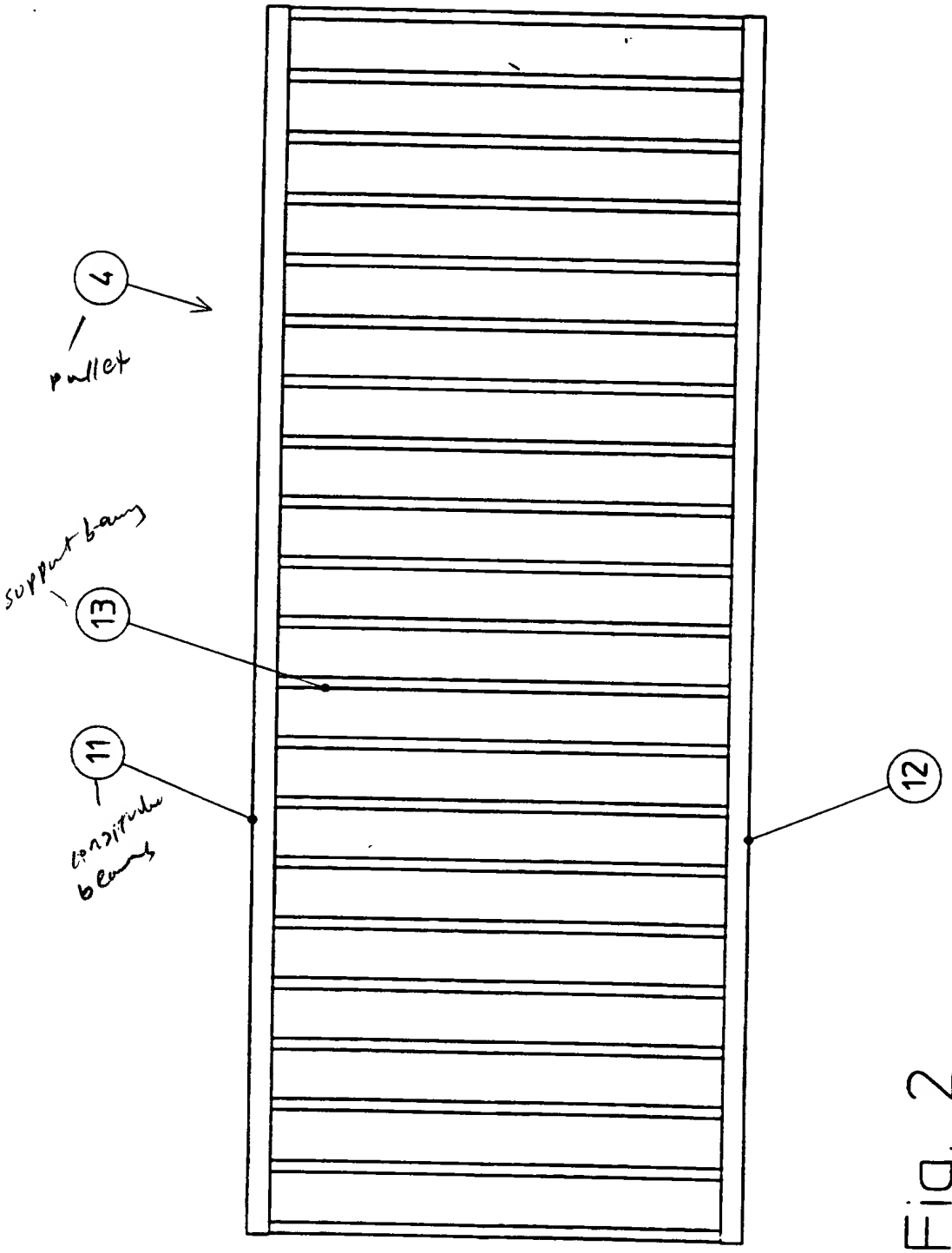

Fig. 2

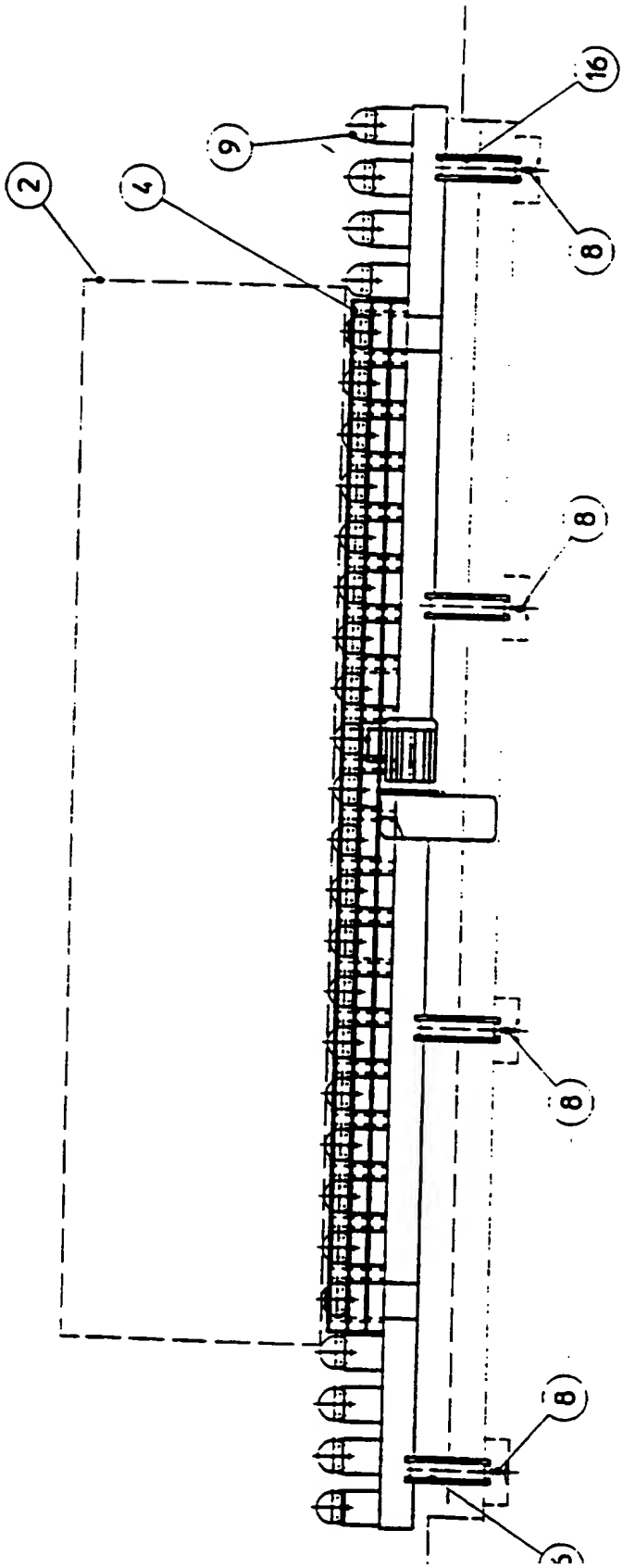

Fig. 3

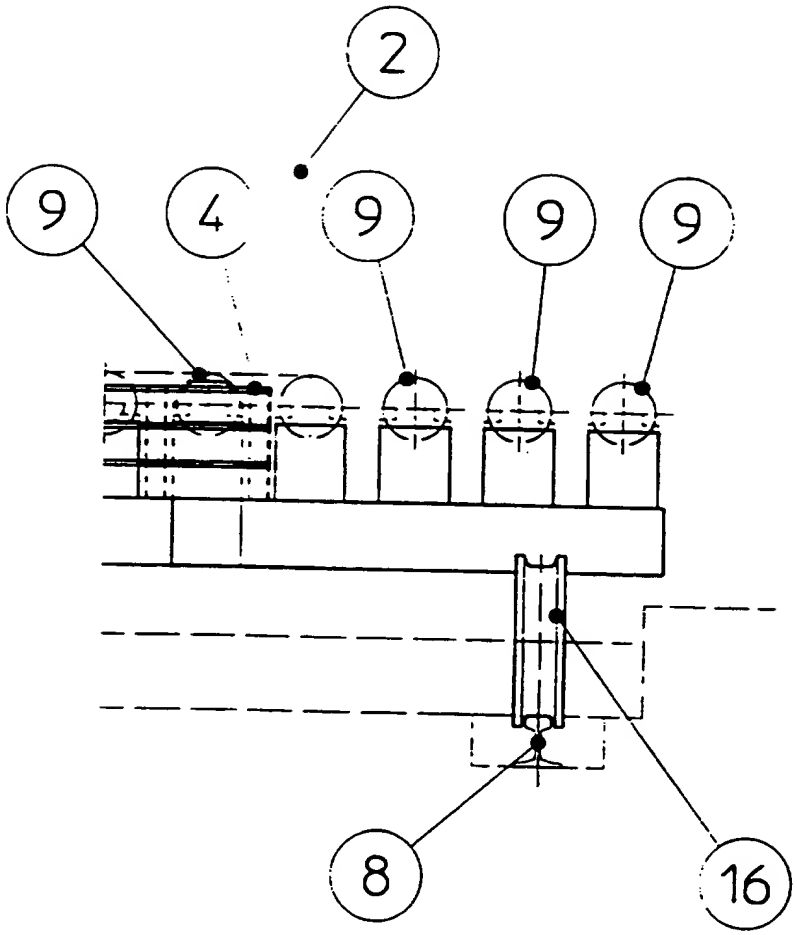

Fig. 4

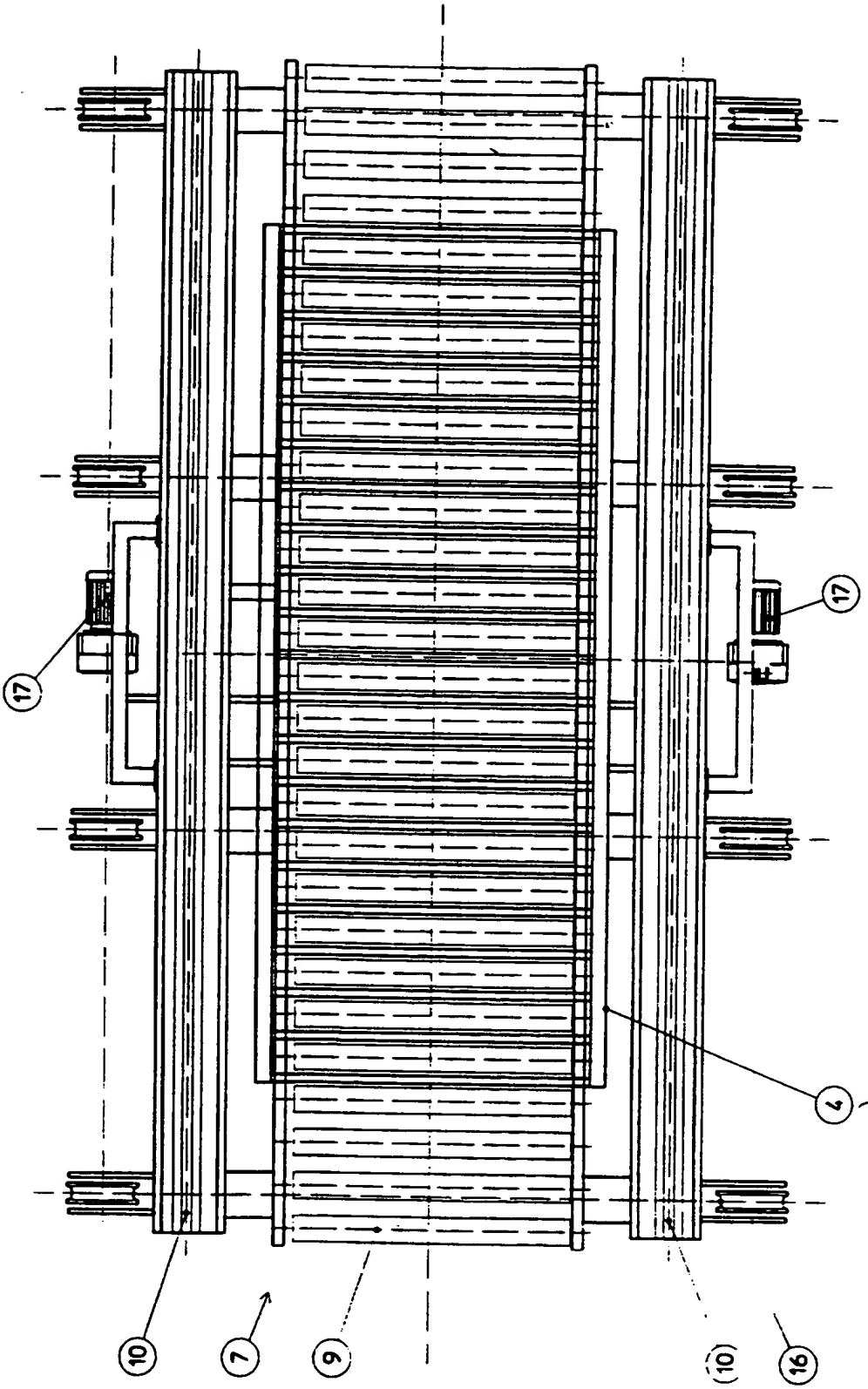

Fig. 5

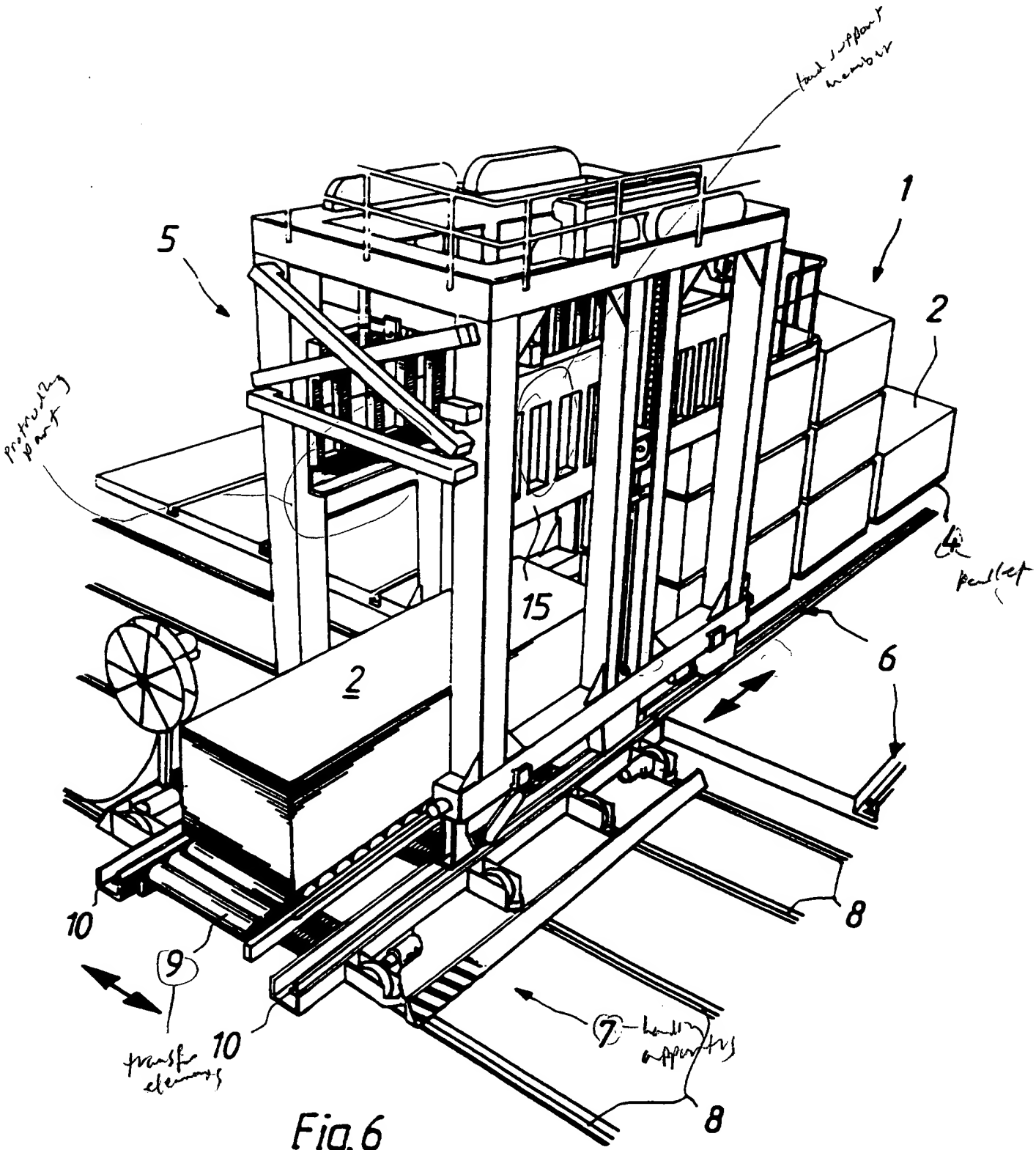

Fig. 6

INTERNATIONAL SEARCH REPORT

Inte..national application No.
PCT/FI 95/00699

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B65G 1/04, B65H 61/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B65G, B65H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPIL, IFIPAT

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	SE 404348 B (PENTAPORT SWEDEN AB), 2 October 1978 (02.10.78) --	1-13
A	FI 47079 C (INTO KERTTULA), 18 May 1972 (18.05.72) --	1-13
A	EP 431346 A2 (KOLBUS GMBH & CO. KG), 12 June 1991 (12.06.91) --	1-13
A	DE 2336710 A1 (WEHNER KG), 6 February 1975 (06.02.75) --	1-13

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
26 April 1996	30 -04- 1996
Name and mailing address of the ISA/ Swedish Patent Offic Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized ficer EDDY LEOPOLD Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 95/00699

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 2519227 A1 (C. KELLER & CO), 18 November 1976 (18.11.76) --	1-13
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